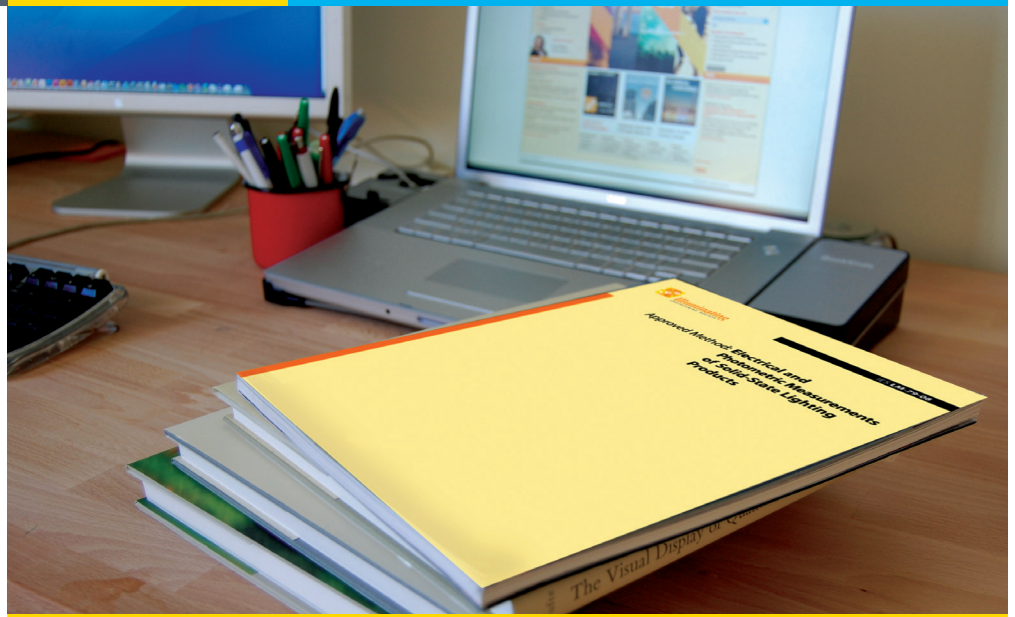


**SOLID-STATE LIGHTING:****Standards Increase  
Market Confidence in  
SSL Performance**

The U.S. Department of Energy supports industry in developing solid-state lighting (SSL) product standards, a vital foundation for market adoption and growth.

The use of national standards and test methods is critical to lighting design and bolsters consumer confidence in products. Like traditional lighting products, LED-based luminaires sold in the United States rely on industry-developed standards and test methods to characterize their performance and safety. However, the unique attributes of LEDs necessitate the development of new standards to effectively measure and characterize this technology.

Until recently, the lack of sufficient standards for SSL generated a great deal of confusion and frustration in the market. Variations in testing methods and terminology from one manufacturer to another made it difficult to compare new LED



Industry organizations are setting standards that account for the unique attributes of SSL products, making it easier for buyers to select the best product for an application.

*Photo courtesy of Akoya.*

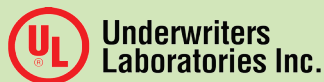
products to other light sources as well as to other LED products.

The U.S. Department of Energy (DOE) has been working closely with a network of standards-setting organizations to accelerate the development and implementation of needed SSL standards. DOE provides standards development support to the process, which includes hosting ongoing workshops to foster coordination and collaboration on related efforts. These workshops are attended by representatives and committee members

from the major standards groups: American National Standards Institute (ANSI), Illuminating Engineering Society of North America (IES), National Electrical Manufacturers Association (NEMA), National Institute of Standards and Technology (NIST), Underwriters Laboratories Inc. (UL), Commission Internationale de l'Eclairage (CIE), CSA International, International Electrotechnical Commission (IEC), and Institute of Electrical and Electronic Engineers (IEEE).

**Current SSL Standards  
and White Papers**

- **ANSI C78.377-2008, Specifications for the Chromaticity of Solid-State Lighting Products**, specifies recommended color ranges for white LEDs with various correlated color temperatures. Color range and color temperature are metrics of critical importance to lighting designers.<sup>1</sup>
- **IES G-2, Guideline for the Application of General Illumination ("White") Light-Emitting Diode (LED) Technologies**, provides lighting and design professionals with a general



understanding of LED technology as it pertains to interior and exterior illumination, as well as useful design and application guidance for effective use of LEDs.<sup>2</sup>

- **IES LM-79-2008, Approved Method for the Electrical and Photometric Testing of Solid-State Lighting Devices**, enables the calculation of LED luminaire efficacy (net light output from the luminaire divided by the input power and measured in lumens per watt). Luminaire efficacy is the most reliable way to measure LED product performance, measuring luminaire performance as a whole instead of relying on traditional methods that separate lamp ratings and fixture efficiency. LM-79 helps establish a foundation for accurate comparisons of luminaire performance, not only for SSL, but for all sources.
- **IES LM-80-2008, Approved Method for Measuring Lumen Depreciation of LED Light Sources**, supports an assessment of expected LED lifetime by defining a method of testing lamp depreciation. Unlike traditional filament-based sources, which usually fail completely, LEDs typically don't fail; they simply fade over time, which is referred to as lumen depreciation. LM-80 establishes a standard method for testing lumen depreciation.
- **IES RP-16 Addenda a and b, Nomenclature and Definitions for Illuminating Engineering**, provides industry-standard definitions for terminology related to SSL.
- **NEMA LSD 45-2009, Recommendations for Solid-State Lighting Sub-Assembly Interfaces for Luminaires**, provides guidance on the design and construction of interconnects (sockets) for SSL applications.<sup>3</sup>
- **NEMA LSD 49-2010, Solid-State Lighting for Incandescent Replacement—Best Practices for Dimming**, provides recommendations for the application of dimming for screw-based incandescent replacement SSL products.
- **NEMA SSL-1, Electric Drivers for LED Devices, Arrays, or Systems**, provides specifications for and operating characteristics of non-integral electronic drivers (power supplies) intended for general lighting applications.
- **NEMA SSL 3-2010, High-Power White LED Binning for General Illumination**, provides a consistent format for categorizing (binning) color varieties of LEDs during their production and integration into lighting products.
- **NEMA SSL-6, Solid State Lighting for Incandescent Replacement—Dimming** provides dimming recommendations for retrofitting SSL products into systems that previously used incandescent screw-base lamps.
- **UL 8750, Safety Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products**, specifies the minimum safety requirements for SSL components, including LEDs and LED arrays, power supplies, and control circuitry.<sup>4</sup>

## Standards in Development

- **CIE TC1-69, Color Quality Scale**, provides a more effective method for relating the color characteristics of lighting products including LEDs.
- **IES LM-XX1, Approved Method for the Measurements of High Power LEDs**
- **IES LM-XX2, LED “Light Engines and Integrated Lamp” Measurements**
- **IES LM-XX3, Approved Method for Measuring Lumen Maintenance of LED Light Engines and LED Integrated and Non-Integrated Lamps**
- **IES TM-21, Method for Estimation of LED Lumen Depreciation as a Measure of Potential LED Life**, is a proposed method for taking LM-80 collected data and estimating an effective life for LEDs.

Over time, these and other standards will remove the guesswork about comparative product performance, making it easier for lighting manufacturers, designers, and specifiers to select the best product for an application. As industry experts continue the painstaking work of standards development, they are contributing to a growing body of information that will help support SSL innovation, as well as market adoption and growth.

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### For More Information

For more information on SSL standards, see [ssl.energy.gov/standards.html](http://ssl.energy.gov/standards.html).

### EERE Information Center

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U.S. DEPARTMENT OF  
**ENERGY** | Energy Efficiency & Renewable Energy

DOE/EE-0374 • June 2011

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1. The C78.377 standard is available for hard copy purchase or as a free download from NEMA at [www.nema.org/stds/ANSI-ANSLG-C78-377.cfm#download](http://www.nema.org/stds/ANSI-ANSLG-C78-377.cfm#download). Hard copies can also be purchased from ANSI at [www.webstore.ansi.org](http://www.webstore.ansi.org).

2. Electronic copies of G-2, LM-79, LM-80 and RP-16 may be purchased online through IES at [www.ies.org/store](http://www.ies.org/store).

3. LSD 45 and LSD 49 are available as free down-loads from NEMA at [www.nema.org/stds/lstd45.cfm#download](http://www.nema.org/stds/lstd45.cfm#download) and [www.nema.org/stds/lstd49.cfm#download](http://www.nema.org/stds/lstd49.cfm#download). SSL-1, SSL-3, and SSL-6 are available for purchase at [www.nema.org/stds](http://www.nema.org/stds).

4. UL customers can obtain the outline for free (with login) at [www.ulstandards.com](http://www.ulstandards.com) or for purchase at [www.comm-2000.com](http://www.comm-2000.com).